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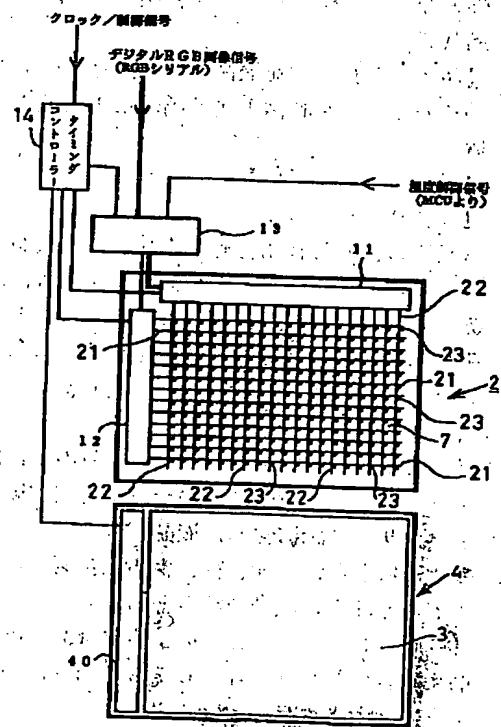
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(54) 【発明の名称】 液晶装置

(57) 【要約】

【課題】 上下輝度サグの無い均一なフルカラー表示が可能となる液晶装置を提供する。

【解決手段】 タイミングコントローラ14にて、赤、緑、青のうちの所定の原色を表示するフレーム期間と、次の赤、緑、青のうちの他の原色を表示するフレーム期間との間に全面黒表示を行う黒表示フレーム期間を設けると共に、黒表示フレーム期間と原色表示フレーム期間との2フレーム分の期間を1周期としてバックライト4を点灯色切り換え点灯させるようにする。これにより、原色画像表示と黒表示とを共に上下スキャン書き込みにより表示することができ、如何なる位置の各画素ラインであってもその表示時間を全て等しくすることができるようにする。



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## 【特許請求の範囲】

【請求項1】 対向する一対の基板に液晶を挟持すると共に、前記一対の基板に情報電極及び走査電極をマトリクス状に配した液晶パネルと、この液晶パネルの背後に配された赤、緑、青各原色発光可能なバックライトとを備え、前記液晶パネルを前記フレーム毎順次赤、緑、青各原色画像信号により駆動すると共に、前記各原色画像信号に同期して前記バックライトを点灯色切り換え点灯させる液晶装置であって、

前記赤、緑、青のうちの所定の原色を表示するフレーム期間と、次の前記赤、緑、青のうちの他の原色を表示するフレーム期間との間に全面黒表示を行う黒表示フレーム期間を設けると共に、前記黒表示フレーム期間と原色表示フレーム期間との2フレーム分の期間を1周期として前記バックライトを点灯色切り換え点灯させるカラー表示制御手段を備えたことを特徴とする液晶装置。

【請求項2】 前記カラー表示制御手段は、前記原色表示フレーム及び黒表示フレームを、前記走査電極に沿って順次前記各原色画像信号及び黒表示信号を書き込むことにより形成することを特徴とする請求項1記載の液晶装置。

【請求項3】 前記カラー表示制御手段は、前記黒表示フレーム期間と原色表示フレーム期間とを等しくしたことを特徴とする請求項1又は2記載の液晶装置。

【請求項4】 前記カラー表示制御手段は、前記黒表示フレーム期間中、前記液晶に印加される黒表示信号電圧と、該黒表示フレーム期間の前又は後の前記原色表示フレーム期間中、前記液晶に印加される原色画像信号電圧とを、全ての画素においてその絶対値が等しくかつ逆極性となるようにしたことを特徴とする請求項1記載の液晶装置。

【請求項5】 前記液晶は、単安定モードの強誘電性液晶であることを特徴とする請求項1又は4記載の液晶装置。

## 【発明の詳細な説明】

## 【0001】

【発明の属する技術分野】本発明は、液晶装置に関し、特に液晶パネルと、この液晶パネルの背後に配された赤、緑、青各原色発光可能なバックライトとを備え、時系列的にRGB原色画像表示をフレーム毎の順次で行うことでカラー表示を行うものに関する。

## 【0002】

【従来の技術】従来、対向する一対の基板に液晶を挟持すると共に、一対の基板の一方に情報電極及び走査電極をマトリクス状に配した液晶パネルと、この液晶パネルの背後に配された赤、緑、青各原色発光可能なバックライトとを備えた液晶装置がある。

【0003】そして、このような液晶装置においては、例えば特公昭63-41078号公報に開示されているように、所謂カラーフィルターレス液晶パネルをフレ-

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ム毎、順次でR (RED)、G (GREEN)、B (BLUE)の各原色画像信号毎に駆動し、それに同期して液晶パネルをバックライトからのRGBの各色光で照明することにより、カラー画像表示を行うようにしている。また、最近の例では同様の方式を強誘電性液晶表示パネルに応用したものが、特開平6-222360号公報、特公平8-27453号公報等に開示されている。

## 【0004】

【発明が解決しようとする課題】しかしながら、このような構成の従来の液晶装置において、一般に液晶パネルは水平ライン毎に順次上から下にスキャン駆動していくため、従来のように単純にフレーム毎に各RGB照明光を切り替える場合、この上下スキャンに応じて各画素ライン毎に表示時間が異なることにより明るさムラ(上下輝度サグ)が発生してしまうという問題点があった。

【0005】なお、この上下輝度サグを完全になくすには、全フレームの書き込みが終了した後と、次のフレームの書き込みが始まるまでの間の時間を実効表示時間とすれば良いが、この場合にはこの実効表示時間は垂直ブランキング期間に相当するものとなり、これを長く設定することには限界があり、カラーフィルターが不要となるにも係わらず表示の十分な明るさが得難いという他の問題点がある。

【0006】そこで、本発明はこのような従来の問題点を解決するためになされたものであり、上下輝度サグの無い均一なフルカラー表示が可能となる液晶装置を提供することを目的とするものである。

## 【0007】

【課題を解決するための手段】本発明は、対向する一対の基板に液晶を挟持すると共に、前記一対の基板に情報電極及び走査電極をマトリクス状に配した液晶パネルと、この液晶パネルの背後に配された赤、緑、青各原色発光可能なバックライトとを備え、前記液晶パネルを前記フレーム毎順次赤、緑、青各原色画像信号により駆動すると共に、前記各原色画像信号に同期して前記バックライトを点灯色切り換え点灯させる液晶装置であって、前記赤、緑、青のうちの所定の原色を表示するフレーム期間と、次の前記赤、緑、青のうちの他の原色を表示するフレーム期間との間に全面黒表示を行う黒表示フレーム期間を設けると共に、前記黒表示フレーム期間と原色表示フレーム期間との2フレーム分の期間を1周期として前記バックライトを点灯色切り換え点灯させるカラー表示制御手段を備えたことを特徴とするものである。

【0008】また本発明は、前記カラー表示制御手段は、前記原色表示フレーム及び黒表示フレームを、前記走査電極に沿って順次前記各原色画像信号及び黒表示信号を書き込むことにより形成することを特徴とするものである。

【0009】また本発明は、前記カラー表示制御手段は、前記黒表示フレーム期間と原色表示フレーム期間と

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を等しくしたことを特徴とするものである。

【0010】また本発明は、前記カラー表示制御手段は、前記黒表示フレーム期間中、前記液晶に印加される黒表示信号電圧と、該黒表示フレーム期間の前又は後の前記原色表示フレーム期間中、前記液晶に印加される原色画像信号電圧とを、全ての画素においてその絶対値が等しくかつ逆極性となるようにしたことを特徴とするものである。

【0011】また本発明は、前記液晶は、単安定モードの強誘電性液晶であることを特徴とするものである。

【0012】また本発明のように、カラー表示制御手段にて、赤、緑、青のうちの所定の原色を表示するフレーム期間と、次の赤、緑、青のうちの他の原色を表示するフレーム期間との間に全面黒表示を行う黒表示フレーム期間を設けると共に、黒表示フレーム期間と原色表示フレーム期間との2フレーム分の期間を1周期としてバックライトを点灯色切り換え点灯させることにより、原色画像表示と黒表示とを共に上下スキャン書き込みにより表示することができ、如何なる位置の各画素ラインであってもその表示時間を全て等しくすることができる。

【0013】また本発明のように、カラー表示制御手段にて、各画像信号の書き込み駆動に際し、全ての画素において、黒表示フレーム期間中、液晶に印加される黒表示信号電圧と、黒表示フレーム期間の前又は後の原色表示フレーム期間中、液晶に印加される原色画像信号電圧とが、その絶対値が等しくかつ逆極性の関係になるようにすることにより、残留DC電圧成分が液晶に残らないようにすることができる。

【0014】

【発明の実施の形態】以下、本発明の実施の形態について図面を用いて説明する。

【0015】図1は、本発明の実施の形態に係る液晶装置の構成を示す図である。同図において、1は液晶装置であり、この液晶装置1は、カラーフィルターを有していない液晶表示パネル2と、その背面側にR (RED) G (GREEN) B (BLACK) 各原色にて発光する面状発光面3を有するバックライト4とを備えている。

【0016】ここで、この液晶表示パネル2は、アクティブマトリックス構成からなり、液晶としては高速応答液晶である単安定モードの強誘電性液晶を用いている(以後FLCと呼ぶ)。なお、このFLCは応答スピードが速く(数百 $\mu$ s～数ms)、通常は(パネルの構成画素数及び駆動電圧等にもよるが)水平スキャン周期に近いレベルの応答速度を有したものである。

【0017】一方、図2は、液晶装置1の断面図であり、同図において、5aは液晶表示パネル2の対抗電極ガラス基板、5bはTFTガラス基板、6はこれら対向する一対の基板5a、5b間に挟持されたFLCである。ここで、TFTガラス基板5bには走査ライン電極、情報ライン電極が形成されており、さらにこれらの

交差部にはTFT、画素電極、補助容量から構成される画素7が形成されている。

【0018】また、各画素7のFLC6は、これらTFT、画素電極、補助容量により、いわゆるアクティブマトリックス駆動されるようになっている。なお、液晶表示パネル2は、図2において、例えば左側から右側(矢印S1方向;図1の上から下に相当)に向かって順次スキャン駆動されるようになっている。

【0019】図3は、液晶装置1のバックライト4の構造を示す断面図(液晶画面上下方向切断)であり、このバックライト4はRGB各4本、計12本の原色蛍光灯(冷陰極管)31R、31G、31Bと、U溝型拡散反射板32と、拡散板33を基本要素としている。

【0020】ここで、RGB原色蛍光灯31R、31G、31Bは、各原色毎に4本ずつ配置されているため、これらを4本ずつまとめて色毎に順次点灯することにより拡散反射板32と拡散板33との光反射及び散乱作用により色切り換え型のRGB原色面状発光が可能となる。

【0021】ところで、この各RGB原色蛍光灯31R、31G、31Bは、図中に示したように、インバーター42と高圧スイッチ41から成る色切り換え点灯回路40を備えており、後述するタイミングコントローラからのタイミング制御信号により任意にバックライト光の色切り換え動作ができるようになっている。なお、このような構成においては、インバーター42は稼働したままで高圧スイッチ41を切り替えるだけでよいことから、インバーターの負荷変動も少なくかつ高速の色切り換えが可能となる。

【0022】一方、図4は、液晶表示パネル2とバックライト4とを駆動する駆動系の構成を示す図であり、同図において、11は情報ラインドライバであり、情報ライン電極22を通じて画像表示信号を各画素7に伝送するものである。また、12は走査ラインドライバであり、走査ライン電極21を通じて走査ライン上の各TFT23を駆動するものである。

【0023】さらに、13は後述する液晶駆動信号を生成する液晶駆動信号発生回路、14はカラー表示制御手段であるタイミングコントローラであり、このタイミングコントローラ14からの制御信号に基づき、液晶表示パネル2の各水平ライン画素(水平方向に並ぶ1画素列)を走査ラインドライバ12により走査ライン電極22及び各TFT23を通じて順次スキャン駆動していくと共に、各水平ライン画素の各情報ライン電極22には情報ラインドライバ11を介して各画像表示信号が供給されるようになっている。

【0024】また、このような画像表示信号書き込み動作に同期して、後述するようにバックライト4も色切り換え点灯回路40により該書き込み画像表示信号(原色)に対応した発光色に切り換えられるようになってい

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る。

【0025】なお、図中に示された外部から加わるクロック、制御信号、温度制御信号は不図示のMCU（制御マイコン）を中心とした総括制御回路からのものである。また、デジタルRGB画像信号についてはパソコン及びビデオ機器とのやはり不図示のインターフェース回路からのものであり、画像フレームメモリーからの読み出しをフレーム毎にRGB順に行ったシリアル変換後の原色画像信号である。

【0026】ところで、このような構成の駆動系において、まずタイミングコントローラー14からの制御信号により、走査ラインドライバ12は、液晶表示パネル2の各水平ライン画素を走査ライン電極22及び各TFT23を通じて順次スキャン駆動していく。そして、この際、同時に情報ラインドライバ11は、各水平ライン画素の各情報ライン電極22に適宜各画像表示信号を供給する。その結果、各画素電極に画像表示信号電圧が供給され、これに対応した液晶の応答及び表示動作が起

【0027】さらに、このような画像表示信号書き込み動作に同期して、バックライト4も色切り換え点灯回路40により該書き込み画像表示信号（原色）に対応した発光色に切り換えられる。

【0028】次に、このような液晶装置1の駆動法についてさらに詳しく説明する。

【0029】液晶表示パネル2の駆動系は情報ラインドライバ11、走査ラインドライバ12、液晶駆動信号発生回路13、TFT23及びタイミングコントローラー14から入力される制御信号等により、図2に示すように左側から右側に向かって各画素7を順次スキャン駆動していくが、まず、水平画素ライン毎に順次黒表示信号（本実施の形態にて用いたFLCモードの特徴を利用した黒表示信号のことであり、詳細は後述する）の書き込みスキャンを1フレーム分行う。次に、R原色画像信号の書き込みスキャンを1フレーム分行う。

【0030】その次は黒、次はG原色、次は黒、次はB原色・・・と1フレーム毎に黒表示と原色画像表示を繰り返しながら、時系列的に隔フレーム毎にRGBRGB・・・と色順次に各原色画像信号を書き込んでいく。

【0031】そして、このようなフレーム順次駆動に同期してバックライト4も液晶表示パネル駆動中の各RGB原色画像信号に対応した原色光で順次点灯する。例えば図2では、前フレームの黒表示画像がG原色画像に書き換えられていく様子を表しており、バックライト4もG光にて照明を行っている。

【0032】図5は、このような液晶表示パネル2の各原色画像信号及び黒表示信号の書き込みによる画像表示と、バックライト4の点灯色切り換えのタイミングチャートである。この図に示すように、バックライト4は液晶表示パネル2への黒表示信号書き込みによる黒表示

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と、その次の原色画像表示の2フレーム分を1周期として、かつこれに同期してこの原色画像表示の原色と同色発光するように順次点灯色を切り替えていく。尚、本例ではフレーム周期を通常の60Hzの6倍の360Hz相当（つまり1/360sec）に設定している。

【0033】なお、本実施の形態では、既述したように原色画像信号を印可する前に黒表示信号を印可しているが、この信号によりFLCはリセット（液晶分子のホームポジションへの戻しであり、黒表示となる）されている。

【0034】ところで、本実施の形態では既述したように単安定モードを採用しているが、このモードの概念図を図6に示す。ここで、同図において、PとAはクロスニコルのポライザーとアナライザーの偏光方向を表している。また、8はFLC分子を模式的に表しており、Pに沿った分子の向きが単安定状態の方向（ホームポジション）であり、黒表示状態となる。

【0035】そして、このFLCに書き込み電圧Vwを印可すると、FLC分子は角度 $\theta$  aチルトする。ここで、このチルト角 $\theta$  aは、FLC分子のスプレー弾性とVwによる駆動力とのバランスにより決まるため、飽和値まではVwと比例的関係となる。従って、透過光強度もVwとほぼ比例的関係を持ち、Vwの値により濃淡の中間調を表示することが可能となる。

【0036】一方、書き込み後には次の書き込みへの影響を無くすため、FLC分子をホームポジションに戻すことが好ましく、この為に所定の黒表示電圧Vr（Vwと逆極性で絶対値が等しい）を印可している。なお、単安定のためVwのoffのみでも戻すが、より早く戻すには逆電圧を掛けたほうが好ましい。

【0037】図7は、このような単安定モードにおけるアクティブ駆動画素での液晶電圧波形と、それに対する光学応答（透過光強度）の関係を示したものである。なお、同図において、Vwは原色画像表示印可電圧、Vrは黒表示印可電圧、tで示す時間軸位置は電圧的には対向電極（対向ガラス基板5a上のベタ電極）電圧を示しており、液晶印可電圧ゼロに相当する。

【0038】また、TGは走査ライン選択期間、つまり各TFTのON期間を表しており、このTG期間にVw、Vrの各信号電圧が各画素の液晶に印可されるようになっている。そして、これらの信号が印可された後は、TFTがオープン状態になるため、その電圧が次のVw又はVr印可までほぼ維持される（厳密には近接信号ラインによる振られやFLCの自発分極の影響があるが、いわゆる補助容量とTFTのドライバビリティを大きめに設計することで小さくすることができる）。

【0039】また、1Fはフレーム周期を表しており、本実施の形態では最初の1F期間を黒表示期間、次の1F期間を原色画像表示期間としている。そして、既述したように黒表示と原色画像表示のペアがRGB順に繰り返

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返されていく。ここで、 $V_r$ の値は次のフレームの $V_w$ と絶対値が等しく、逆極性電圧になるように設定している。つまり、原色画像信号の極性反転信号を黒表示信号として1フレーム分書き込んだ後に、本来の原色画像信号を書き込み表示している。

【0040】これにより、各画素の液晶層に掛かる実効 $VT$ 積（実効電圧×時間）が黒表示期間と原色画像表示期間とで完全にキャンセルされ、液晶に悪影響（焼き付き等）を及ぼす残留 $DC$ 電圧成分が皆無となるため、表示品質の信頼性が著しく向上するようになる。

【0041】そして、このように黒表示と原色画像表示とを順次スキャン駆動する方法を取ることににより、実効表示期間は通常の液晶パネルに比較して丁度50%（半分）となる。従って、瞬間的な画像表示としては図8に模式的に示したように、原色画像表示フレームの場合には $V_w$ 印可画素ラインの下側に黒表示領域が存在し、 $V_w$ 印可ラインが下がっていくに従って原色画像表示に切り替わっていき、また、黒表示フレームの場合には $V_r$ 印可画素ラインの下側に前のフレームの原色画像表示領域が存在し、 $V_r$ 印可ラインが下がっていくに従って黒表示に切り替わっていく。このようにして黒表示領域と原色表示の境界が $V_w$ 及び $V_r$ の上下スキャン駆動と共に画面の上から下に向かって流れていく。

【0042】ここで、この黒表示領域の上端の1つ上の画素ラインが $V_w$ 印可（原色画像信号書き込み）位置、同じくこの黒表示領域の下端画素ラインが $V_r$ 印可（黒表示信号書き込み）位置に対応している。そして、既述したように原色画像表示は黒表示フレームを挟んで隔フレーム順次で $RGB$ の各原色毎に行われ、実際の表示としてはこの黒表示領域の上下スキャンとともにその前後で各原色フレーム画像も上下スキャンしながら $RGB$ 順次に切り替わって行く。

【0043】図8はちょうど黒表示が $R$ 画像に書き換えられていく瞬間と、 $G$ 画像が黒表示に書き換えられていく瞬間とを表わしてしているものである。また、図2については断面図ではあるが黒表示が $G$ 画像に書き換えられていく瞬間を表している。また既述したようにフレーム周期としては360Hz相当に設定しているため、このような黒表示と原色画像表示とが交互に起こっても、それはフリッカー限界を超えており、ちらつき等の不具合は全く発生しない。

【0044】このように、本実施の形態では丁度1画面分（1フレーム分）の黒表示領域が存在する。そして、バックライト4の色光の切り替えは、図5のタイミングチャートに示したように黒表示フレームから原色画像表示フレームに切り替わる際に、表示画像原色と同色の点灯色に切り替えている。

【0045】従って、その各走査画素ライン毎の表示状態をタイミングチャートで表すと図9に示すようになる。つまり、画面上どの画素ライン位置に於いても各原

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色画像の表示時間は1フレーム相当になると共に、1フレーム分の黒表示の存在により各原色フレーム画像間のクロストークも全く発生しない。

【0046】そして、このように原色画像表示と黒表示とを共に上下スキャン書き込みにより表示することにより、如何なる位置の各画素ラインであってもその表示時間は全て等しくなり、前記したような明るさムラ（上下輝度サグ）の無い、非常に良好なフルカラー表示が形成される。

10 【0047】一方、図10は、液晶表示パネル2の $FLC6$ の駆動及び応答動作と、それに対応したバックライト4の点灯色切り換えのタイミングチャートである。これは1つの水平画素ラインに注目したタイミングチャートであるが、既述した液晶表示パネルとバックライトの諸動作をまとめて表している。

20 【0048】ここで、注意が必要な点は、既述したように黒表示信号の $V_r$ と、その次の原色画像信号の $V_w$ とは同じ原色画像信号の極性反転信号ということでペアを成しているが、ある原色のバックライト点灯期間としてはその原色の画像表示フレーム期間とその次の黒表示フレーム期間に跨っていることである。ここで、このようにバックライトの点灯期間が、次の黒表示フレームにまで及んでいることについては、図9のチャートから明らかなように特に下端部の水平画素ラインの表示期間を維持する為に必須である。

30 【0049】一方、黒表示と共に次の $V_w$ を $DC$ 的にキャンセルする目的を有する $V_r$ を該 $V_w$ の前に印可させることについては、この $V_r$ 印可の1フレーム前に印可された原色画像信号により発生しうる残留的現象（電気化学的現象等）が、次の原色画像信号（ $V_w$ ）から作られた極性反転した $V_r$ 印可（液晶分子リセットも伴う）がなされることにより次に来る該 $V_w$ 書き込みに対してほとんど影響し得なくなるという利点がある。

【0050】但し、この効果は微細なものであり、このようにペアをなす $V_r$ と $V_w$ の順番を逆にして $V_w$ の後にこの $V_w$ の $DC$ 的キャンセル兼黒表示の $V_r$ を印可するという、本実施の形態と逆の関係（ $V_w$ と $V_r$ ）のフレーム駆動にしても大きな支障は無い。

40 【0051】なお、 $V_w$ 、 $V_r$ の各液晶駆動信号は液晶駆動信号発生回路13にて生成され、外部から入力されるデジタル $RGB$ 原色画像信号に基づき、MCUからの温度制御信号による温度補償や液晶特有の階調特性の補正等を盛り込んだ信号（電圧）となっている（図3参照）。また、この $V_w$ 、 $V_r$ は共に同じ情報ライン電極22を通じて各画素に供給される。

【0052】ところで、これまで説明したように、黒表示と各 $RGB$ 原色画像表示とを交互に、かつフレーム順次で行ってフルカラー画像を表示することにより、その実効表示期間は2フレーム周期当たり1フレーム周期と（効率50%）なるが、カラーフィルターによる透過ロ

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スが無いため、総合的には従来の液晶パネルと同等の明るさ（光利用効率）が得られると共に、上下輝度サグの全く無い均一なフルカラー表示画像表示が可能となる。

【0053】また、黒表示と各RGB原色画像表示とで液晶層に掛かるDC電圧分をキャンセルするような駆動法を取っている為、前のフレームでの書き込み状態（Vw電圧）が次のフレームでの書き込みに影響せず、いわゆる残像・焼き付きの無い非常に良好な画像（特に動画）が長時間動作に於いても安定した状態で得ることができる。

【0054】なお、本実施の形態においては、液晶表示パネルとしてTFTによるアクティブマトリックス構造かつアクティブ駆動によるものを用いたが、例えば単純マトリックス構造かつパッシブ駆動の液晶表示パネルについても、少なくとも180～360Hz相当のフレーム周期駆動が可能な（実際の液晶の駆動速度はこのフレーム周波数の走査ライン数倍の速度が必要）特に高速なタイプ又はモードのFLC等を用いることにより全く同様に扱うことができる。

【0055】また、バックライトとしては基本的にRGB原色蛍光灯を多数並べて構成しているが、各蛍光灯の蛍光体としては各原色画像フレーム間クロストーク防止のため、消灯立ち下がり特性として1ms以下の残光の少ないタイプのものを用いることが好ましい。また、バックライトを構成するにあたって、原色蛍光灯の代わりに、RGB原色発光可能なLEDを光源として、同様な色切り換え点灯回路と共に構成しても全く差し支えない。

【0056】

【発明の効果】以上説明したように本発明によれば、原色表示フレーム期間の間に全面黒表示を行う黒表示フレーム期間を設けると共に黒表示フレーム期間と原色表示フレーム期間との2フレーム分の期間を1周期としてバックライトを点灯色切り換え点灯させることにより、原色画像表示と黒表示とを共に上下スキヤン書き込みにより表示することができる。これにより、如何なる位置の各画素ラインであってもその表示時間を全て等しくすることができ、上下輝度サグの無い均一なフルカラー表示

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が可能となる。

【図面の簡単な説明】

【図1】本発明の実施の形態に係る液晶装置の構成を示す図。

【図2】上記液晶装置の断面図。

【図3】上記液晶装置のバックライトの構造を示す図。

【図4】上記液晶装置の液晶表示パネルとバックライトとを駆動する駆動系の構成を示すブロック図。

【図5】上記液晶表示パネルの画像表示とバックライト点灯色切り換えのタイミングチャート。

【図6】上記液晶表示パネルに用いられる単安定モードFLCの概念図。

【図7】上記FLCに印加される液晶電圧波形とその光学応答波形を示す図。

【図8】上記液晶表示パネルのある瞬間の表示状態を表す模式図。

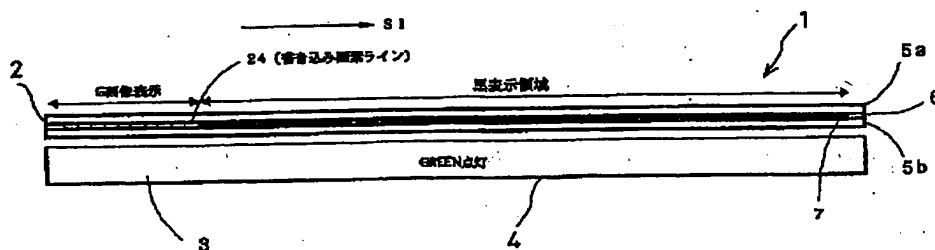
【図9】上記液晶表示パネルの各水平画素ラインにおける表示状態のタイミングチャート。

【図10】上記液晶表示パネルの画像信号書き込みと、液晶応答と、バックライト点灯色切り換えのタイミングチャート。

【符号の説明】

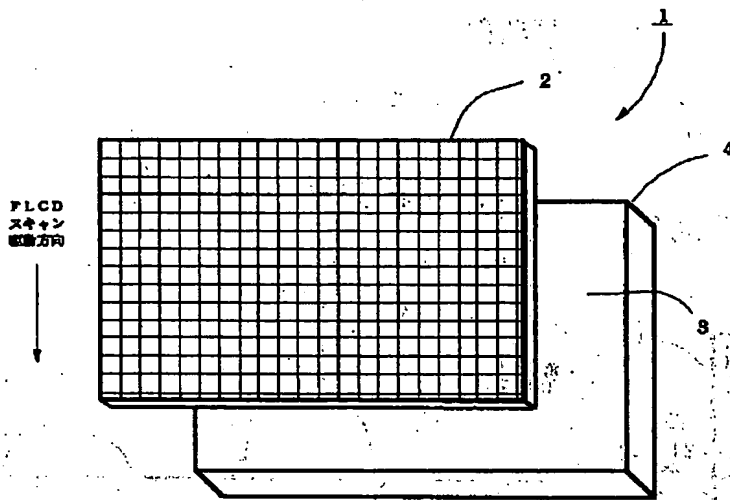
- |     |                 |
|-----|-----------------|
| 1   | 液晶装置            |
| 2   | 液晶表示パネル         |
| 3   | 面状発光面           |
| 4   | バックライト          |
| 5 a | 対抗電極ガラス基板       |
| 5 b | TFTガラス基板        |
| 6   | 強誘電性液晶（FLC）     |
| 7   | 画素              |
| 8   | 強誘電性液晶（FLC）分子   |
| 14  | タイミングコントローラー    |
| 21  | 走査ライン電極         |
| 22  | 情報ライン電極         |
| 23  | TFT             |
| 31  | RGB原色蛍光灯        |
| 40  | バックライト色切り換え点灯回路 |

【図2】

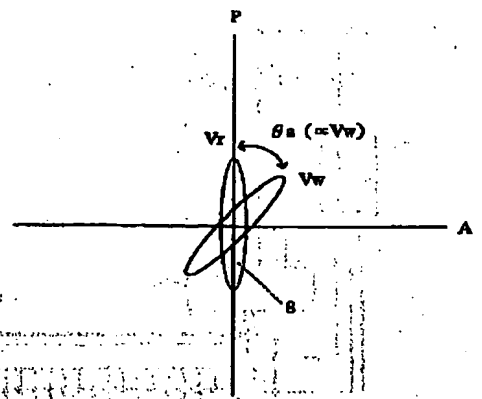


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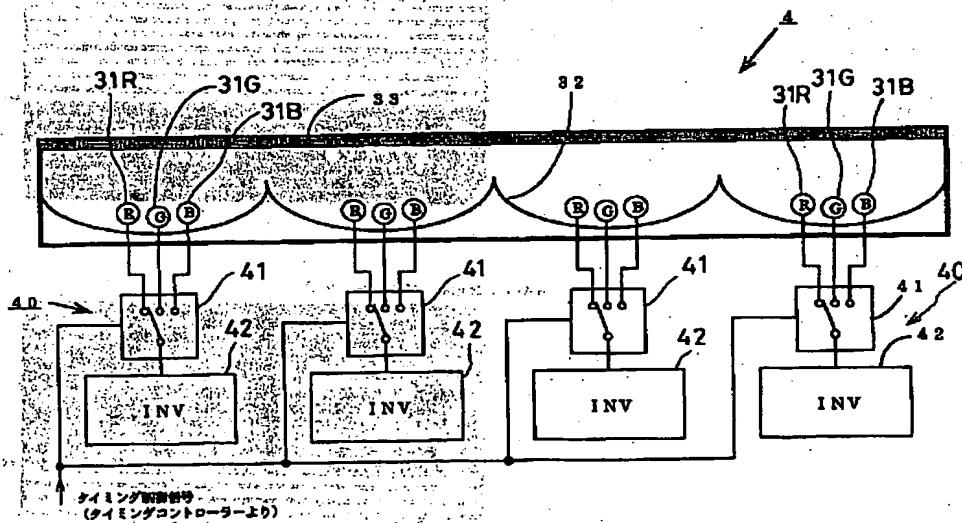
【図1】



【図6】

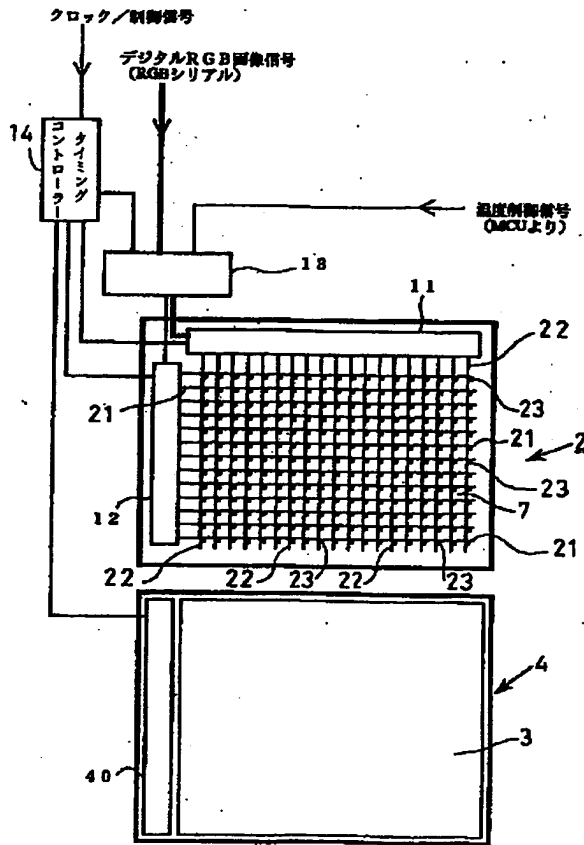


【図3】

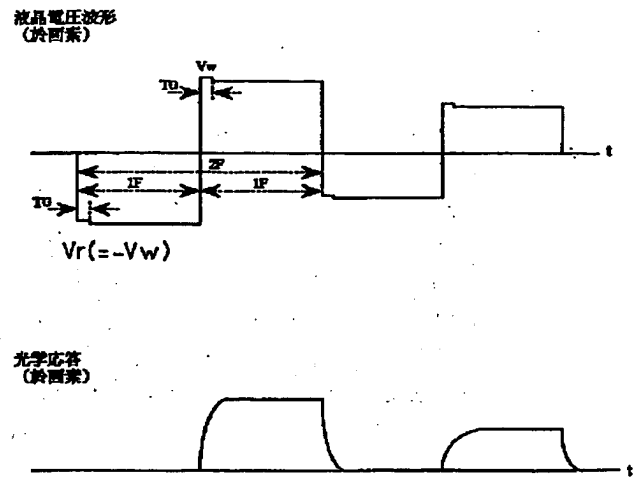


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【図4】



【図7】

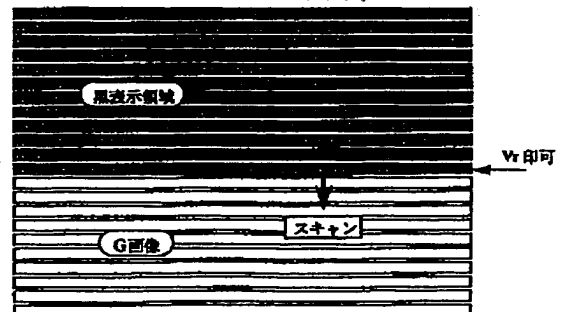


【図8】

スキャン表示例 (ある瞬間その1)

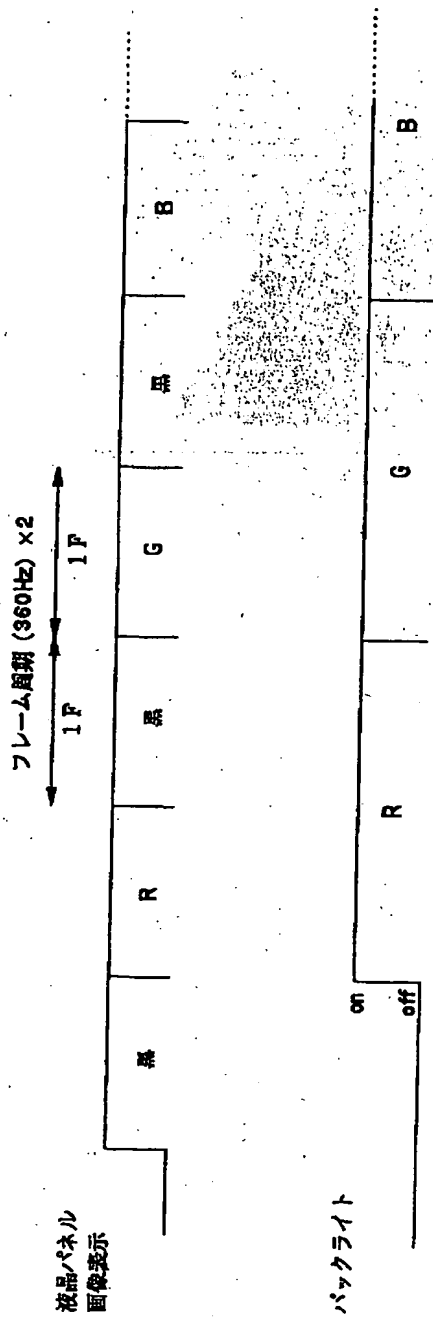


スキャン表示例 (ある瞬間その2)

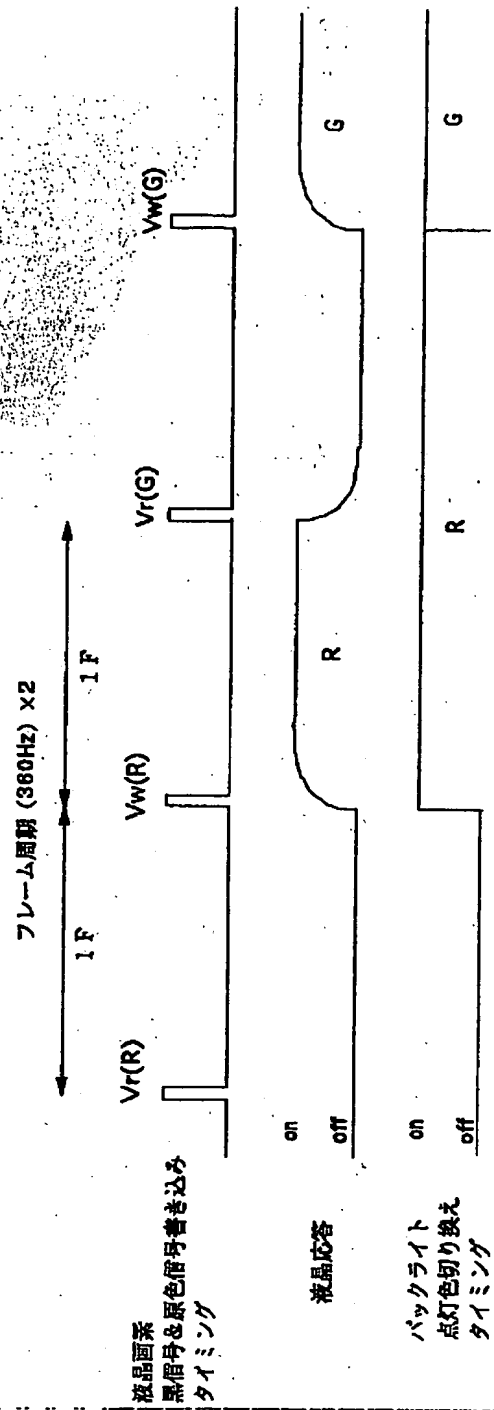


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【図5】

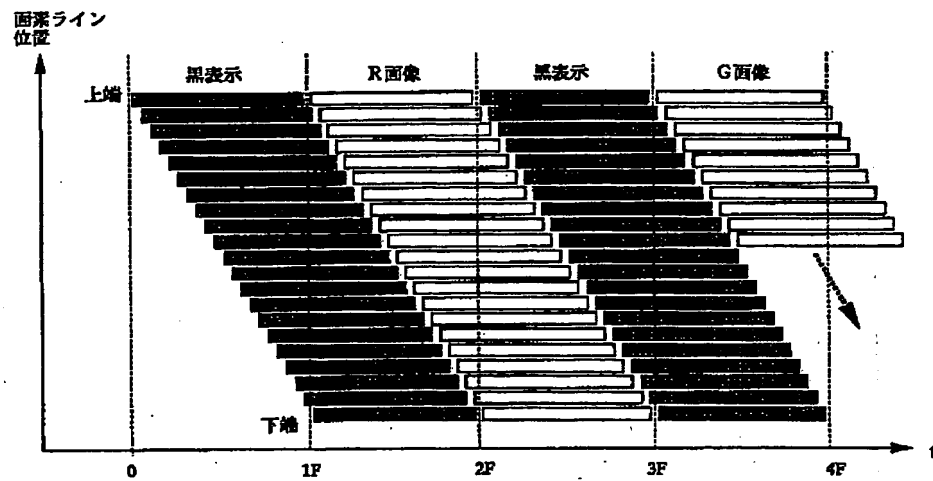


【図10】



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【図9】



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**CLAIMS**

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**[Claim(s)]**

[Claim 1] The liquid crystal panel which arranged the information electrode and the scan electrode on the substrate of said pair in the shape of a matrix while pinching liquid crystal to the substrate of the pair which counters, While having the back light in which the red allotted behind this liquid crystal panel, green, and \*\*\*\* primary color luminescence are possible and driving said liquid crystal panel with sequential red, green, and a \*\*\*\* primary color picture signal said whole frame The frame period which is liquid crystal equipment which carries out lighting colour switching lighting of said back light synchronizing with said each primary color picture signal, and displays the predetermined primary color of said red, green, and the blue, While establishing the black display frame period which performs a whole surface black display between said next red, green, and the frame period that displays other primary colors of the blue Liquid crystal equipment characterized by having the color display control means which carries out lighting colour switching lighting of said back light by making the period for two frames of said black display frame period and a primary color display frame period into one period.

[Claim 2] Said color display control means is liquid crystal equipment according to claim 1 characterized by forming said primary color display frame and a black display frame by writing in sequential aforementioned each primary color picture signal and a black status signal along with said scan electrode.

[Claim 3] Said color display control means is liquid crystal equipment according to claim 1 or 2 characterized by making equal said black display frame period and a primary color display frame period.

[Claim 4] The black display signal level with which said color display control means is impressed to said liquid crystal during said black display frame period, and the front stirrup of this black display frame period are liquid crystal equipment according to claim 1 characterized by making the primary color picture signal electrical potential difference impressed to said liquid crystal during said next primary color display frame period the absolute value serve as reversed polarity equally in all pixels.

[Claim 5] Said liquid crystal is liquid crystal equipment according to claim 1 or 4 characterized by being the ferroelectric liquid crystal in the monostable mode.

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**DETAILED DESCRIPTION**

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] Especially this invention is equipped with a liquid crystal panel and the back light in which the red allotted behind this liquid crystal panel, green, and \*\*\*\* primary color luminescence are possible about liquid crystal equipment, and relates to what performs color display by performing RGB primary color image display by sequential [ for every frame ] serially.

[0002]

[Description of the Prior Art] While pinching liquid crystal conventionally to the substrate of the pair which counters, there is liquid crystal equipment equipped with the liquid crystal panel which arranged the information electrode and the scan electrode on one side of the substrate of a pair in the shape of a matrix, and the back light in which the red allotted behind this liquid crystal panel, green, and \*\*\*\* primary color luminescence are possible.

[0003] And in such liquid crystal equipment, the so-called color filter loess liquid crystal panel is driven by every frame and sequential for every primary color picture signal of R (RED), G (GREEN), and B (BLUE), and it is made to perform a color picture display by illuminating a liquid crystal panel by each colored light of RGB from a back light synchronizing with it as indicated by JP,63-41078,B, for example. Moreover, in the latest example, what applied the same method to the ferroelectric liquid crystal display panel is indicated by JP,6-222360,A, JP,8-27453,B, etc.

[0004]

[Problem(s) to be Solved by the Invention] However, in the conventional liquid crystal equipment of such a configuration, generally, in order for the liquid crystal panel to turn the scanning drive down from the top one by one for every level Rhine, when each RGB illumination light was simply changed for every frame like before, and display time differed for every pixel Rhine according to this vertical scan, it had the trouble that brightness nonuniformity (vertical brightness sag) will occur.

[0005] In addition, although this effective display time becomes effective display time, then a thing equivalent to a perpendicular blanking period in this case about time amount in order to lose this vertical brightness sag completely, after the writing of all frames is completed, until the writing of the following frame starts although it is good, there is a limitation in setting this up for a long time and a color filter becomes unnecessary, there are other troubles that sufficient brightness of a display is difficult to get.

[0006] Then, it is made in order that this invention may solve such a conventional trouble, and it aims at offering the liquid crystal equipment whose uniform full color display without a vertical brightness sag is attained.

[0007]

[Means for Solving the Problem] The liquid crystal panel which arranged the information electrode and the scan electrode on the substrate of said pair in the shape of a matrix while this invention pinched liquid crystal to the substrate of the pair which counters, While having the back light in which the red allotted behind this liquid crystal panel, green, and \*\*\*\* primary color luminescence are possible and driving said liquid crystal panel with sequential red, green, and a \*\*\*\* primary color picture signal said whole frame The frame period which is liquid crystal

equipment which carries out lighting colour switching lighting of said back light synchronizing with said each primary color picture signal, and displays the predetermined primary color of said red, green, and the blue, While establishing the black display frame period which performs a whole surface black display between said next red, green, and the frame period that displays other primary colors of the blue It is characterized by having the color display control means which carries out lighting colour switching lighting of said back light by making the period for two frames of said black display frame period and a primary color display frame period into one period.

[0008] Moreover, this invention is characterized by said color display control means forming said primary color display frame and a black display frame by writing in sequential aforementioned each primary color picture signal and a black status signal along with said scan electrode.

[0009] Moreover, this invention is characterized by said color display control means making equal said black display frame period and a primary color display frame period.

[0010] Moreover, the black display signal level with which said color display control means is impressed to said liquid crystal for this invention during said black display frame period, and the front stirrup of this black display frame period are characterized by making the primary color picture signal electrical potential difference impressed to said liquid crystal the absolute value serve as reversed polarity equal in all pixels during said next primary color display frame period.

[0011] Moreover, this invention is characterized by said liquid crystal being a ferroelectric liquid crystal in the monostable mode.

[0012] Moreover, the frame period which displays the predetermined primary color of red, green, and the blue in a color display control means like this invention, While establishing the black display frame period which performs a whole surface black display between the next red, green, and the frame period that displays other primary colors of the blue By carrying out lighting colour switching lighting of the back light by making the period for two frames of a black display frame period and a primary color display frame period into one period Both primary color image display and a black display can be displayed by vertical scan writing, and even if it is each pixel Rhine of what kind of location, the whole of the display time can be made equal.

[0013] moreover, this invention — like — a color display control means — the write-in drive of each picture signal — the time — all pixels — setting — The black display signal level impressed to liquid crystal during a black display frame period, and the front stirrup of a black display frame period During a next primary color display frame period, When making it the primary color picture signal electrical potential difference impressed to liquid crystal become [ the absolute value ] equal the relation of reversed polarity, a residual DC voltage component can be prevented from remaining in liquid crystal.

[0014]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained using a drawing.

[0015] Drawing 1 is drawing showing the configuration of the liquid crystal equipment concerning the gestalt of operation of this invention. In this drawing, 1 is liquid crystal equipment and this liquid crystal equipment 1 is equipped with the liquid crystal display panel 2 which does not have the color filter, and the back light 4 which has the field-like luminescence side 3 which emits light with R(RED) G(GREEN) B (BLACK) each primary color to that tooth-back side.

[0016] Here, this liquid crystal display panel 2 consists of an active-matrix configuration, and the ferroelectric liquid crystal in the monostable mode which is high-speed response liquid crystal as liquid crystal is used (henceforth referred to as FLC). in addition, this FLC — response speed — the speed of response of the level near a level scanning interval quick (hundreds of microseconds — several ms) usually (based on the number of configuration pixels, driver voltage, etc. of a panel) — an owner — it is a thing the bottom.

[0017] On the other hand, drawing 2 is the sectional view of liquid crystal equipment 1, and the confrontation electrode glass substrate of the liquid crystal display panel 2 and 5b of 5a are FLC by which a TFT glass substrate and 6 were pinched between substrate 5a of the pair which these-counters, and 5b in this drawing. Here, the scan line electrode and the information Rhine electrode are formed in TFT glass substrate 5b, and the pixel 7 which consists of TFT, a pixel

electrode, and auxiliary capacity is further formed in these intersections.

[0018] moreover, FLC6 of each pixel 7 — these TFT(s), a pixel electrode, and auxiliary capacity — being the so-called — an active-matrix drive is carried out. In addition, in drawing 2, the sequential scan drive of the liquid crystal display panel 2 is carried out toward right-hand side (arrow-head S1 direction; considerable from drawing 1 to the bottom) from left-hand side.

[0019] Drawing 3 is the sectional view (the liquid crystal screen vertical direction cutting) showing the structure of the back light 4 of liquid crystal equipment 1, and this back light 4 is using four RGB each, a total of 12 primary color fluorescent lamps (cold cathode tube) 31R, 31G, and 31B, U ditch type diffuse reflection plate 32, and the diffusion plate 33 as the base element.

[0020] Here, since four RGB primary color fluorescent lamps 31R, 31G, and 31B are arranged for every [ each ] primary color, RGB primary color side-like luminescence of a colour switching mold of them is attained according to the light reflex of the diffuse reflection plate 32 and the diffusion plate 33, and a dispersion operation by carrying out sequential lighting of these [ four / every ] for every color collectively.

[0021] By the way, as each of these RGB primary color fluorescent lamps 31R, 31G, and 31B were shown all over drawing, it has the colour switching lighting circuit 40 which consists of an inverter 42 and the high-pressure switch 41, and colour switching actuation of back light light has come be made to arbitration with the timing control signal from the timing controller mentioned later. In addition, in such a configuration, since an inverter 42 should just change the high-pressure switch 41, working, it becomes there are also few load effects of an inverter and possible for them high-speed to lighting color change it.

[0022] On the other hand, drawing 4 is drawing showing the configuration of the drive system which drives the liquid crystal display panel 2 and a back light 4, and in this drawing, 11 is an information line driver and transmits an image display signal to each pixel 7 through the information Rhine electrode 22. Moreover, 12 is a scan line driver and drives each TFT23 on a scan line through the scan line electrode 21.

[0023] Furthermore, the liquid crystal drive signal generating circuit which generates the liquid crystal driving signal which 13 mentions later, 14 is a timing controller which is a color display control means, the control signal from this timing controller 14 — being based — each level Rhine pixel (1-pixel train horizontally located in a line) of the liquid crystal display panel 2 — the scan line driver 12 — the scan line electrode 22 and every, while carrying out the sequential scan drive through TFT23 Each image display signal is supplied to each information Rhine electrode 22 of each level Rhine pixel through the information line driver 11.

[0024] Moreover, synchronizing with such image display signal write-in actuation, a back light 4 is also switched to the luminescent color corresponding to this write-in image display signal (primary color) by the colour switching lighting circuit 40 so that it may mention later.

[0025] In addition, the clock added from the outside shown all over drawing, a control signal, and a temperature control signal are the things from the multiple-unit-control circuit centering on non-illustrated MCU (control microcomputer). Moreover, about a digital RGB picture signal, it is a primary color picture signal after the serial conversion with a personal computer and video equipment which is a thing from a non-illustrated interface circuitry too, and performed read-out from an image frame memory in order of RGB for every frame.

[0026] By the way, in the drive system of such a configuration, the scan line driver 12 carries out the sequential scan drive of each level Rhine pixel of the liquid crystal display panel 2 through the scan line electrode 22 and each TFT23 with the control signal from the timing controller 14 first. And the information line driver 11 supplies each image display signal to each information Rhine electrode 22 of each level Rhine pixel suitably at coincidence in this case. Consequently, an image display signal level is supplied to each pixel electrode, and the response and display action of liquid crystal corresponding to this happen.

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[0028] Next, it explains in more detail about the method of driving such liquid crystal equipment 1.

[0029] The drive system of the liquid crystal display panel 2 with the control signal inputted from the information line driver 11, the scan line driver 12, the liquid crystal drive signal generating circuit 13, TFT23, and the timing controller 14 Although the sequential scan drive of each pixel 7 is carried out toward right-hand side from left-hand side as shown in drawing 2 First, the write-in scan of a black status signal (it is the thing using the description in the FLC mode used with the gestalt of this operation of a black status signal, and mentions later for details) is performed by one frame one by one for every level pixel Rhine. Next, the write-in scan of R primary color picture signal is performed by one frame.

[0030] the degree — black and a degree — G primary color and a degree — black and a degree — B primary color — while repeating a black display and primary color image display for every [ .... and ] frame — serial — every \*\* frame — RGBRGB ... and a color order — next, each primary color picture signal is written in.

[0031] And synchronizing with such a frame sequential drive, a back light 4 also carries out sequential lighting by the primary lights corresponding to each RGB primary color picture signal under liquid crystal display panel drive. For example, the black display image of a front frame expresses with drawing 2 signs that it is rewritten by G primary color image, and the back light 4 is also illuminating with G light.

[0032] Drawing 5 is the timing chart of the image display by the writing of each primary color picture signal of such a liquid crystal display panel 2, and a black status signal, and the lighting colour switching of a back light 4. As shown in this drawing, the back light 4 changes the sequential lighting color so that same color luminescence may be carried out with the primary color of this primary color image display synchronizing with this by making two frames of the black display by the black status signal writing to the liquid crystal display panel 2, and its next primary color image display into one period. In addition, in this example, the frame period is set as 360Hz (that is, 1/360sec) of 6 60Hz usual times.

[0033] In addition, although the seal of approval of the black status signal is carried out with the gestalt of this operation before carrying out the seal of approval of the primary color picture signal, as mentioned already, FLC is reset by this signal (it is return of home POJISHONHE of a liquid crystal molecule, and becomes a black display).

[0034] By the way, although the monostable mode is adopted with the gestalt of this operation as mentioned already, the conceptual diagram in this mode is shown in drawing 6 . Here, in this drawing, P and A express the polarization direction of the polarizer of a cross Nicol's prism, and an analyzer. Moreover, 8 expresses the FLC molecule typically, and the sense of the molecule in alignment with P is the direction of a monostable condition (home position), and it will be in a black display condition.

[0035] And if it writes in this FLC and the seal of approval of the electrical potential difference  $V_w$  is carried out, an FLC molecule will be carried out an include-angle  $\theta_{aa}$  tilt. Here, since this tilt angle  $\theta_{aa}$  is decided by balance of the spray elasticity of an FLC molecule, and the driving force by  $V_w$ , it becomes  $V_w$  and the-like-proportionally relation to a saturation value. Therefore, transmitted light reinforcement also has the-like-proportionally relation mostly with  $V_w$ , and becomes possible [ displaying the halftone of a shade with the value of  $V_w$  ].

[0036] On the other hand, in order to lose the effect of the writing on a degree after writing, it is desirable to return an FLC molecule to a home position, and, for this reason, it is carrying out the seal of approval of the predetermined black display electrical potential difference  $V_r$  (an absolute value is equal at  $V_w$  and reversed polarity). In addition, since it is monostable, it is [ which is  $V_w$  ] more desirable to apply reverse voltage for returning early more, although only off returns.

[0037] Drawing 7 indicates the relation of the optical response (transmitted light reinforcement) to it to be a liquid crystal voltage waveform in the active drive pixel in such the monostable mode. In addition, in this drawing, the time-axis location which shows  $V_w$  on a primary color image display seal-of-approval electrical potential difference, and shows  $V_r$  by the black display seal-of-approval electrical potential difference and t shows the counterelectrode (solid electrode on opposite glass substrate 5a) electrical potential difference in electrical potential difference, and is equivalent to liquid crystal seal-of-approval electrical-potential-difference zero.

[0038] moreover, TG — a scan line selection period, i.e., every, — ON period of TFT is expressed and the seal of approval of each signal level of Vw and Vr is carried out to the liquid crystal of each pixel at this TG period. And since TFT will be in an opening condition after the seal of approval of these signals is carried out, the electrical potential difference is mostly maintained to following Vw or following Vr seal of approval (although it is shaken and has the influence of the spontaneous polarization of \*\* FLC, it can be made small by the thing which are strictly depended on a contiguity signal line and for which the so-called driveability of auxiliary capacity and TFT is designed more greatly).

[0039] Moreover, 1F express the frame period and make the black display period and the 1F next period the primary color image display period for the first 1F period with the gestalt of this operation. And as mentioned already, the pair of a black display and primary color image display is repeated in order of RGB. Here, the value of Vr has equal following Vw and following absolute value of a frame, and it is set up so that it may become a reversed-polarity electrical potential difference. That is, after writing it in by one frame, using the polarity-reversals signal of a primary color picture signal as a black status signal, original primary color image \*\*\*\* is written in and displayed.

[0040] Thereby, the effective VT product (effective voltage x time amount) concerning the liquid crystal layer of each pixel is completely canceled in a black display period and a primary color image display period, and since the residual DC voltage component which has bad influences (printing, etc.) on liquid crystal becomes that there is nothing, the dependability of display quality comes to improve remarkably.

[0041] And an effective display period becomes 50% (one half) exactly as compared with the usual liquid crystal panel by taking the approach of carrying out the sequential scan drive of a black display and the primary color image display in this way. Therefore, it changes to the black display as were typically shown in drawing 8 as momentary image display, and a black viewing area exists at Vw seal-of-approval pixel Rhine bottom in the case of a primary color image display frame, it changes to primary color image display as Vw seal-of-approval Rhine falls, and the primary color image display field of a front frame exists at Vr seal-of-approval pixel Rhine bottom in the case of a black display frame and Vr seal-of-approval Rhine falls. Thus, the boundary of a black viewing area and a primary color display flows toward the bottom from on the screen with the vertical scan drive of Vw and Vr.

[0042] here, — pixel Rhine on one of the upper limit of this black viewing area — Vw seal-of-approval (primary color picture signal writing) location — similarly lower limit pixel Rhine of this black viewing area supports Vr seal-of-approval (black status signal writing) location. And as mentioned already, primary color image display is performed for every primary color of RGB by \*\* frame sequential on both sides of a black display frame, and while each primary color frame image also carries out a vertical scan before and behind that with the vertical scan of this black viewing area as an actual display, it changes to RGB sequential and it goes.

[0043] Drawing 8 is expressing and carrying out the moment the moment the black display is exactly rewritten by R image, and G image are rewritten by the black display. Moreover, about drawing 2, although it is a sectional view, the moment the black display is rewritten by G image is expressed. Moreover, since it has set as 360Hz as a frame period as mentioned already, even if such a black display and primary color image display happen by turns, it has exceeded the flicker limitation and faults, such as a flicker, are not generated at all.

[0044] Thus, with the gestalt of this operation, the black viewing area for one screen (one frame) exists exactly. And as shown in the timing chart of drawing 5, in case the change of the colored light of a back light 4 changes from a black display frame to a primary color image display frame, it is changed to display image primary color and the lighting color of the same color.

[0045] Therefore, when the display condition for every scan pixel Rhine of that is expressed with a timing chart, it comes to be shown in drawing 9. That is, while the display time of each primary color image becomes one frame in every pixel Rhine location on a screen, the cross talk between each primary color frame image is not generated at all by existence of a black display for one frame, either.

[0046] And by displaying both primary color image display and a black display by vertical scan

writing in this way, even if it is each pixel Rhine of what kind of location, the very good full color display which the whole of the display time becomes equal, and does not have brightness nonuniformity (vertical brightness sag) which was mentioned above is formed.

[0047] On the other hand, drawing 10 is the timing chart of the drive of FLC6 of the liquid crystal display panel 2 and response actuation, and the lighting colour switching of the back light 4 corresponding to it. Although this is the timing chart which observed one level pixel Rhine, it expresses collectively [ this ] many actuation of a liquid crystal display panel and a back light mentioned already.

[0048] Here, although Vr and Vw of the following primary color picture signal of a black status signal have accomplished the pair by the polarity-reversals signal of the same primary color picture signal as having mentioned the point being warned already, they are straddling the image display frame period and the next black display frame period of the primary color as a back light lighting period of a certain primary color. Here, in this way, about having attained to even the following black display frame, the lighting period of a back light is indispensable in order to maintain the display period of level pixel Rhine of the lower limit section so that especially clearly from the chart of drawing 9.

[0049] About carrying out the seal of approval of the Vr which, on the other hand, has the purpose which cancels the next Vw in DC with a black display before [ of Vw ] this The residual-phenomena (electrochemical phenomenon etc.) which may be generated with the primary color picture signal by which the seal of approval was carried out one frame before this Vr seal of approval There is an advantage of stopping almost influencing to this Vw writing that comes to a degree by making inverted Vr seal of approval (accompanied also by liquid crystal molecule reset) which was made from the following primary color picture signal (Vw).

[0050] However, even if it makes it the frame drive of relation (Vw and Vr) contrary to the gestalt of this operation of this effectiveness being detailed, and making reverse sequence of Vr and Vw of making a pair in this way, and carrying out the seal of approval of the Vr of this black [ DC-cancellation-cum- ] display of Vw after Vw, there is no big trouble.

[0051] In addition, each liquid crystal driving signal of Vw and Vr is generated by the liquid crystal drive signal generating circuit 13, and is the signal (electrical potential difference) which incorporated temperature compensation, amendment of a gradation property peculiar to liquid crystal, etc. by the temperature control signal from MCU based on the digital RGB primary color picture signal inputted from the outside (refer to drawing 3). Moreover, this Vw and Vr are supplied [ both ] to each pixel through the same information Rhine electrode 22.

[0052] by the way, it explained until now — as — a black display and each RGB primary color image display — alternation — and, although the effective display period serves as 1 frame period per 2 frame periods by carrying out by frame sequential and displaying a full color image (50% of effectiveness) In order that there may be no transparency loss by the color filter, while brightness (efficiency for light utilization) equivalent to the conventional liquid crystal panel is obtained synthetically, the uniform full color display image display of a vertical brightness sag which is not is attained.

[0053] Moreover, since the driving method which cancels a part for DC electrical potential difference which starts a liquid crystal layer by a black display and each RGB primary color image display is taken, the write-in condition (Vw electrical potential difference) in a front frame does not influence the writing in the following frame, but where a very good image (especially animation) without so-called after-image and printing is stabilized also in prolonged actuation, it can obtain.

[0054] In addition, although what is depended on the active-matrix structure and the active drive by TFT as a liquid crystal display panel was used in the gestalt of this operation for example, also about simple Matt Rix structure and the liquid crystal display panel of a passive drive It can completely treat similarly by using FLC in an especially high-speed type or the mode in which the frame period drive of at least 180-360Hz is possible (a rate several times the scan line of this frame frequency of this is the need for the drive rate of actual liquid crystal).

[0055] Moreover, although many RGB primary color fluorescent lamps are fundamentally put in order and constituted as a back light, as a fluorescent substance of each fluorescent lamp, it is

desirable to use the thing of the afterglow for 1 or less ms type [ little ] as a putting-out-lights falling property because of each primary color image inter-frame cross talk prevention. Moreover, in constituting a back light, instead of a primary color fluorescent lamp, by making into the light source LED in which RGB primary color luminescence is possible, even if constituted with the same colour switching lighting circuit, it does not interfere at all.

[0056]

[Effect of the Invention] As explained above, while establishing the black display frame period which performs a whole surface black display between primary color display frame periods according to this invention, both primary color image display and a black display can be displayed by vertical scan writing by carrying out lighting colour switching lighting of the back light by making the period for two frames of a black display frame period and a primary color display frame period into one period. By this, even if it is each pixel Rhine of what kind of location, the whole of the display time can be made equal, and the uniform full color display without a vertical brightness sag is attained.

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[Translation done.]

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**TECHNICAL FIELD**

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[Field of the Invention] Especially this invention is equipped with a liquid crystal panel and the back light in which the red allotted behind this liquid crystal panel, green, and \*\*\*\* primary color luminescence are possible about liquid crystal equipment, and relates to what performs color display by performing RGB primary color image display by sequential [ for every frame ] serially.

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**MEANS**

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[Means for Solving the Problem] The liquid crystal panel which arranged the information electrode and the scan electrode on the substrate of said pair in the shape of a matrix while this invention pinched liquid crystal to the substrate of the pair which counters, While having the back light in which the red allotted behind this liquid crystal panel, green, and \*\*\*\* primary color luminescence are possible and driving said liquid crystal panel with sequential red, green, and a \*\*\*\* primary color picture signal said whole frame The frame period which is liquid crystal equipment which carries out lighting colour switching lighting of said back light synchronizing with said each primary color picture signal, and displays the predetermined primary color of said red, green, and the blue, While establishing the black display frame period which performs a whole surface black display between said next red, green, and the frame period that displays other primary colors of the blue It is characterized by having the color display control means which carries out lighting colour switching lighting of said back light by making the period for two frames of said black display frame period and a primary color display frame period into one period.

[0008] Moreover, this invention is characterized by said color display control means forming said primary color display frame and a black display frame by writing in sequential aforementioned each primary color picture signal and a black status signal along with said scan electrode.

[0009] Moreover, this invention is characterized by said color display control means making equal said black display frame period and a primary color display frame period.

[0010] Moreover, the black display signal level with which said color display control means is impressed to said liquid crystal for this invention during said black display frame period, and the front stirrup of this black display frame period are characterized by making the primary color picture signal electrical potential difference impressed to said liquid crystal the absolute value serve as reversed polarity equal in all pixels during said next primary color display frame period.

[0011] Moreover, this invention is characterized by said liquid crystal being a ferroelectric liquid crystal in the monostable mode.

[0012] Moreover, the frame period which displays the predetermined primary color of red, green, and the blue in a color display control means like this invention, While establishing the black display frame period which performs a whole surface black display between the next red, green, and the frame period that displays other primary colors of the blue By carrying out lighting colour switching lighting of the back light by making the period for two frames of a black display frame period and a primary color display frame period into one period Both primary color image display and a black display can be displayed by vertical scan writing, and even if it is each pixel Rhine of what kind of location, the whole of the display time can be made equal.

[0013] moreover, this invention — like — a color display control means — the write-in drive of each picture signal — the time — all pixels — setting — The black display signal level impressed to liquid crystal during a black display frame period, and the front stirrup of a black display frame period During a next primary color display frame period, When making it the primary color picture signal electrical potential difference impressed to liquid crystal become [ the absolute value ] equal the relation of reversed polarity, a residual DC voltage component can be prevented from remaining in liquid crystal.

[0014]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained using a drawing.

[0015] Drawing 1 is drawing showing the configuration of the liquid crystal equipment concerning the gestalt of operation of this invention. In this drawing, 1 is liquid crystal equipment and this liquid crystal equipment 1 is equipped with the liquid crystal display panel 2 which does not have the color filter, and the back light 4 which has the field-like luminescence side 3 which emits light with R(RED) G(GREEN) B (BLACK) each primary color to that tooth-back side.

[0016] Here, this liquid crystal display panel 2 consists of an active-matrix configuration, and the ferroelectric liquid crystal in the monostable mode which is high-speed response liquid crystal as liquid crystal is used (henceforth referred to as FLC). in addition, this FLC — response speed — the speed of response of the level near a level scanning interval quick (hundreds of microseconds — several ms) usually (based on the number of configuration pixels, driver voltage, etc. of a panel) — an owner — it is a thing the bottom.

[0017] On the other hand, drawing 2 is the sectional view of liquid crystal equipment 1, and the confrontation electrode glass substrate of the liquid crystal display panel 2 and 5b of 5a are FLC by which a TFT glass substrate and 6 were pinched between substrate 5a of the pair which these-counters, and 5b in this drawing. Here, the scan line electrode and the information Rhine electrode are formed in TFT glass substrate 5b, and the pixel 7 which consists of TFT, a pixel electrode, and auxiliary capacity is further formed in these intersections.

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[0037] Drawing 7 indicates the relation of the optical response (transmitted light reinforcement) to it to be a liquid crystal voltage waveform in the active drive pixel in such the monostable mode. In addition, in this drawing, the time-axis location which shows  $V_w$  on a primary color image display seal-of-approval electrical potential difference, and shows  $V_r$  by the black display seal-of-approval electrical potential difference and  $t$  shows the counterelectrode (solid electrode on opposite glass substrate 5a) electrical potential difference in electrical potential difference, and is equivalent to liquid crystal seal-of-approval electrical-potential-difference zero.

[0038] moreover, TG — a scan line selection period, i.e., every, — ON period of TFT is expressed and the seal of approval of each signal level of  $V_w$  and  $V_r$  is carried out to the liquid crystal of each pixel at this TG period. And since TFT will be in an opening condition after the seal of approval of these signals is carried out, the electrical potential difference is mostly maintained to following  $V_w$  or following  $V_r$  seal of approval (although it is shaken and has the influence of the spontaneous polarization of \*\* FLC, it can be made small by the thing which are strictly depended on a contiguity signal line and for which the so-called driveability of auxiliary capacity and TFT is designed more greatly).

[0039] Moreover, 1F express the frame period and make the black display period and the 1F next period the primary color image display period for the first 1F period with the gestalt of this operation. And as mentioned already, the pair of a black display and primary color image display is repeated in order of RGB. Here, the value of  $V_r$  has equal following  $V_w$  and following absolute value of a frame, and it is set up so that it may become a reversed-polarity electrical potential difference. That is, after writing it in by one frame, using the polarity-reversals signal of a primary color picture signal as a black status signal, original primary color image \*\*\*\* is written in and displayed.

[0040] Thereby, the effective VT product (effective voltage x time amount) concerning the liquid crystal layer of each pixel is completely canceled in a black display period and a primary color image display period, and since the residual DC voltage component which has bad influences (printing etc.) on liquid crystal becomes that there is nothing, the dependability of display quality comes to improve remarkably.

[0041] And an effective display period becomes 50% (one half) exactly as compared with the usual liquid crystal panel by taking the approach of carrying out the sequential scan drive of a black display and the primary color image display in this way. Therefore, it changes to the black display as were typically shown in drawing 8 as momentary image display, and a black viewing area exists at  $V_w$  seal-of-approval pixel Rhine bottom in the case of a primary color image display frame, it changes to primary color image display as  $V_w$  seal-of-approval Rhine falls, and the primary color image display field of a front frame exists at  $V_r$  seal-of-approval pixel Rhine bottom in the case of a black display frame and  $V_r$  seal-of-approval Rhine falls. Thus, the boundary of a black viewing area and a primary color display flows toward the bottom from on the screen with the vertical scan drive of  $V_w$  and  $V_r$ .

[0042] here — pixel Rhine on one of the upper limit of this black viewing area —  $V_w$  seal-of-approval (primary color picture signal writing) location — similarly lower limit pixel Rhine of this black viewing area supports  $V_r$  seal-of-approval (black status signal writing) location. And as mentioned already, primary color image display is performed for every primary color of RGB by

\*\* frame sequential on both sides of a black display frame, and while each primary color frame image also carries out a vertical scan before and behind that with the vertical scan of this black viewing area as an actual display, it changes to RGB sequential and it goes.

[0043] Drawing 8 is expressing and carrying out the moment the moment the black display is exactly rewritten by R image, and G image are rewritten by the black display. Moreover, about drawing 2, although it is a sectional view, the moment the black display is rewritten by G image is expressed. Moreover, since it has set as 360Hz as a frame period as mentioned already, even if such a black display and primary color image display happen by turns, it has exceeded the flicker limitation and faults, such as a flicker, are not generated at all.

[0044] Thus, with the gestalt of this operation, the black viewing area for one screen (one frame) exists exactly. And as shown in the timing chart of drawing 5, in case the change of the colored light of a back light 4 changes from a black display frame to a primary color image display frame, it is changed to display image primary color and the lighting color of the same color.

[0045] Therefore, when the display condition for every scan pixel Rhine of that is expressed with a timing chart, it comes to be shown in drawing 9. That is, while the display time of each primary color image becomes one frame in every pixel Rhine location on a screen, the cross talk between each primary color frame image is not generated at all by existence of a black display for one frame, either.

[0046] And by displaying both primary color image display and a black display by vertical scan writing in this way, even if it is each pixel Rhine of what kind of location, the very good full color display which the whole of the display time becomes equal, and does not have brightness nonuniformity (vertical brightness sag) which was mentioned above is formed.

[0047] On the other hand, drawing 10 is the timing chart of the drive of FLC6 of the liquid crystal display panel 2 and response actuation, and the lighting colour switching of the back light 4 corresponding to it. Although this is the timing chart which observed one level pixel Rhine, it expresses collectively [ this ] many actuation of a liquid crystal display panel and a back light mentioned already.

[0048] Here, although Vr and Vw of the following primary color picture signal of a black status signal have accomplished the pair by the polarity-reversals signal of the same primary color picture signal as having mentioned the point being warned already, they are straddling the image display frame period and the next black display frame period of the primary color as a back light lighting period of a certain primary color. Here, in this way, about having attained to even the following black display frame, the lighting period of a back light is indispensable in order to maintain the display period of level pixel Rhine of the lower limit section so that especially clearly from the chart of drawing 9.

[0049] About carrying out the seal of approval of the Vr which, on the other hand, has the purpose which cancels the next Vw in DC with a black display before [ of Vw ] this The residual-phenomena (electrochemical phenomenon etc.) which may be generated with the primary color picture signal by which the seal of approval was carried out one frame before this Vr seal of approval There is an advantage of stopping almost influencing to this Vw writing that comes to a degree by making inverted Vr seal of approval (accompanied also by liquid crystal molecule reset) which was made from the following primary color picture signal (Vw).

[0050] However, even if it makes it the frame drive of relation (Vw and Vr) contrary to the gestalt of this operation of this effectiveness being detailed, and making reverse sequence of Vr and Vw of making a pair in this way, and carrying out the seal of approval of the Vr of this black [ DC-cancellation-cum- ] display of Vw after Vw, there is no big trouble.

[0051] In addition, each liquid crystal driving signal of Vw and Vr is generated by the liquid crystal drive signal generating circuit 13, and is the signal (electrical potential difference) which incorporated temperature compensation, amendment of a gradation property peculiar to liquid crystal, etc. by the temperature control signal from MCU based on the digital RGB primary color picture signal inputted from the outside (refer to drawing 3). Moreover, this Vw and Vr are supplied [ both ] to each pixel through the same information Rhine electrode 22.

[0052] by the way, it explained until now — as — a black display and each RGB primary color image display — alternation — and, although the effective display period serves as 1 frame

period per 2 frame periods by carrying out by frame sequential and displaying a full color image (50% of effectiveness) In order that there may be no transparency loss by the color filter, while brightness (efficiency for light utilization) equivalent to the conventional liquid crystal panel is obtained synthetically, the uniform full color display image display of a vertical brightness sag which is not is attained.

[0053] Moreover, since the driving method which cancels a part for DC electrical potential difference which starts a liquid crystal layer by a black display and each RGB primary color image display is taken, the write-in condition ( $V_w$  electrical potential difference) in a front frame does not influence the writing in the following frame, but where a very good image (especially animation) without so-called after-image and printing is stabilized also in prolonged actuation, it can obtain.

[0054] In addition, although what is depended on the active-matrix structure and the active drive by TFT as a liquid crystal display panel was used in the gestalt of this operation for example, also about simple Matt Rix structure and the liquid crystal display panel of a passive drive It can completely treat similarly by using FLC in an especially high-speed type or the mode in which the frame period drive of at least 180-360Hz is possible (a rate several times the scan line of this frame frequency of this is the need for the drive rate of actual liquid crystal).

[0055] Moreover, although many RGB primary color fluorescent lamps are fundamentally put in order and constituted as a back light, as a fluorescent substance of each fluorescent lamp, it is desirable to use the thing of the afterglow for 1 or less ms type [ little ] as a putting-out-lights falling property because of each primary color image inter-frame cross talk prevention.

Moreover, in constituting a back light, instead of a primary color fluorescent lamp, by making into the light source LED in which RGB primary color luminescence is possible, even if constituted with the same colour switching lighting circuit, it does not interfere at all.

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2.\*\*\*\* shows the word which can not be translated.

3.In the drawings, any words are not translated.

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] Drawing showing the configuration of the liquid crystal equipment concerning the gestalt of operation of this invention.

[Drawing 2] The sectional view of the above-mentioned liquid crystal equipment.

[Drawing 3] Drawing showing the structure of the back light of the above-mentioned liquid crystal equipment.

[Drawing 4] The block diagram showing the configuration of the drive system which drives the liquid crystal display panel and back light of the above-mentioned liquid crystal equipment.

[Drawing 5] The image display of the above-mentioned liquid crystal display panel, and the timing chart of back light lighting colour switching.

[Drawing 6] The conceptual diagram in the monostable mode FLC used for the above-mentioned liquid crystal display panel.

[Drawing 7] Drawing showing the liquid crystal voltage waveform impressed to Above FLC, and its optical response waveform.

[Drawing 8] The mimetic diagram showing the display condition of the moment there is the above-mentioned liquid crystal display panel.

[Drawing 9] The timing chart of the display condition in each level pixel Rhine of the above-mentioned liquid crystal display panel.

[Drawing 10] The picture signal writing of the above-mentioned liquid crystal display panel, a liquid crystal response, and the timing chart of back light lighting colour switching.

[Description of Notations]

1 Liquid Crystal Equipment

2 Liquid Crystal Display Panel

3 Field-like Luminescence Side

4 Back Light

5a Confrontation electrode glass substrate

5b TFT glass substrate

6 Ferroelectric Liquid Crystal (FLC)

7 Pixel

8 Ferroelectric Liquid Crystal (FLC) Molecule

14 Timing Controller

21 Scan Line Electrode

22 Information Rhine Electrode

23 TFT

31 RGB Primary Color Fluorescent Lamp

40 Back Light Colour Switching Lighting Circuit

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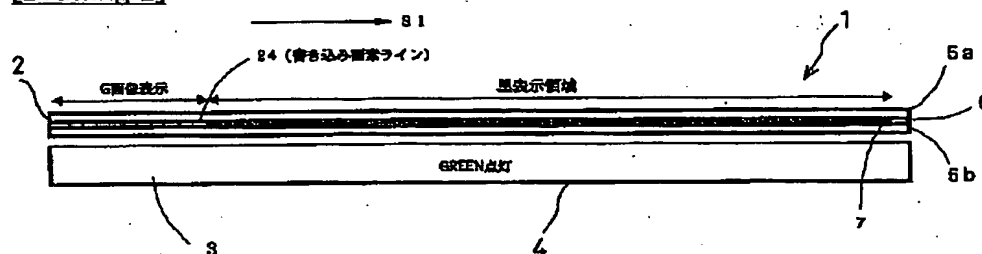
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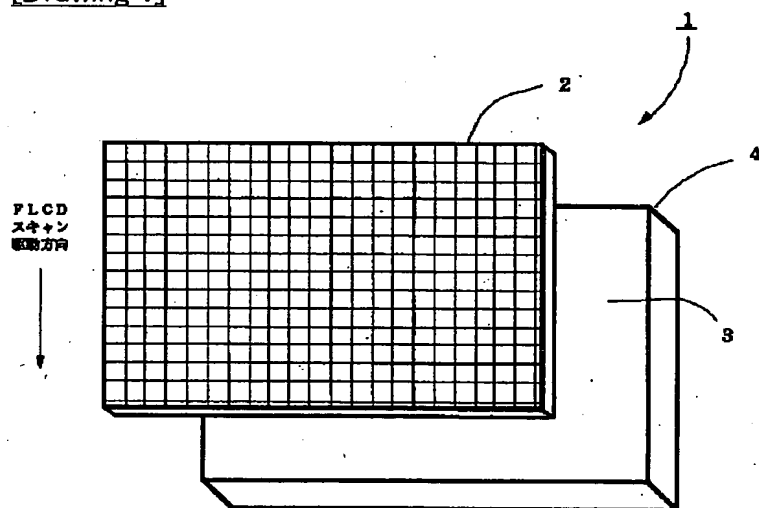
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## DRAWINGS

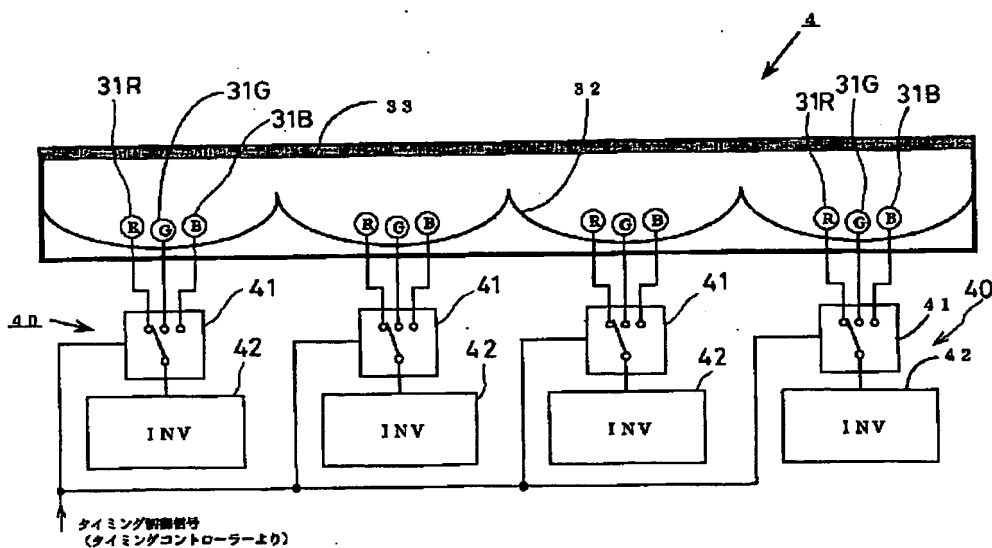
[Drawing 2]



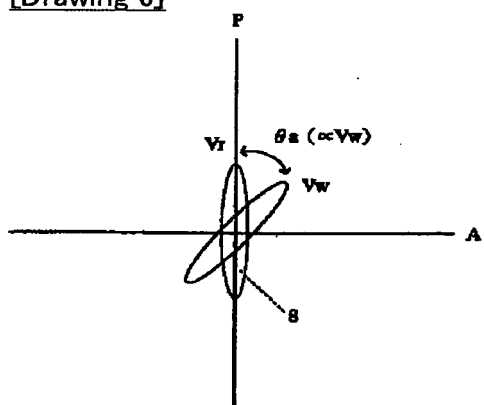
[Drawing 1]



[Drawing 3]



[Drawing 6]



[Drawing 4]

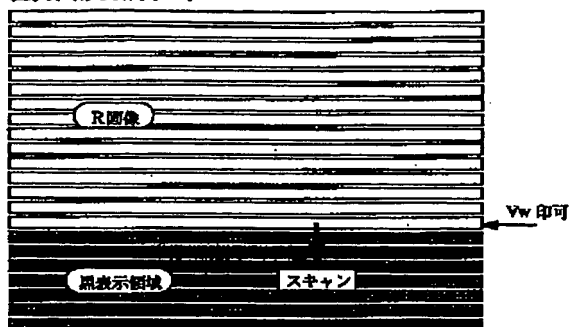


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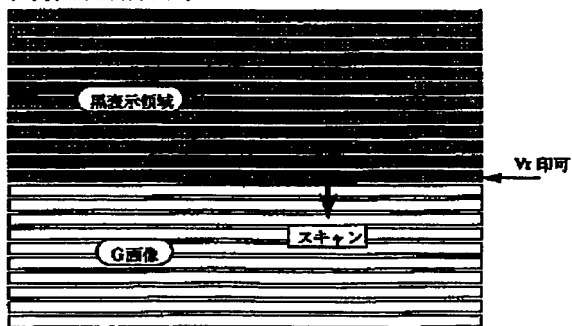


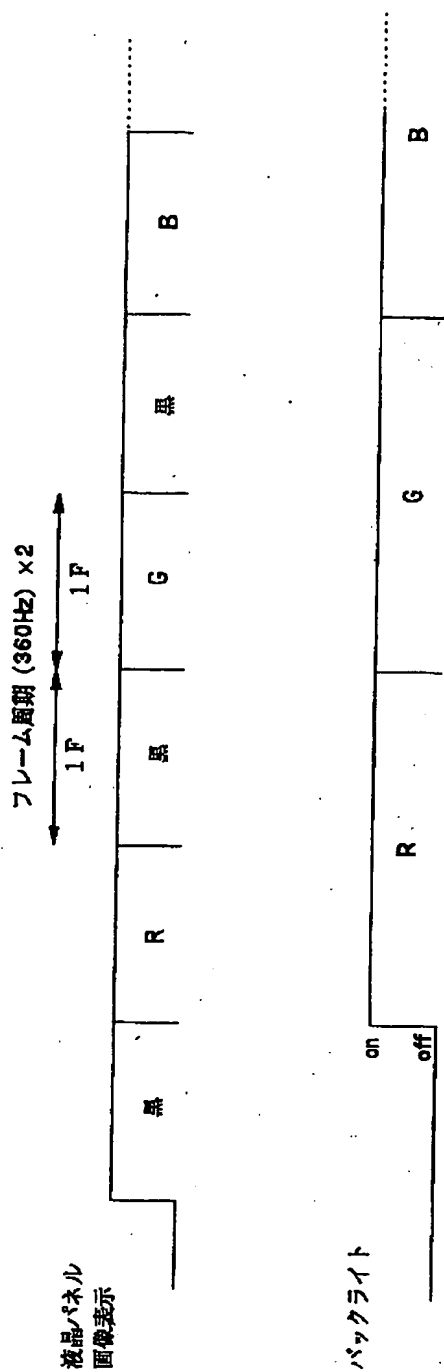
[Drawing 8]

スキャン表示例（ある瞬間その1）

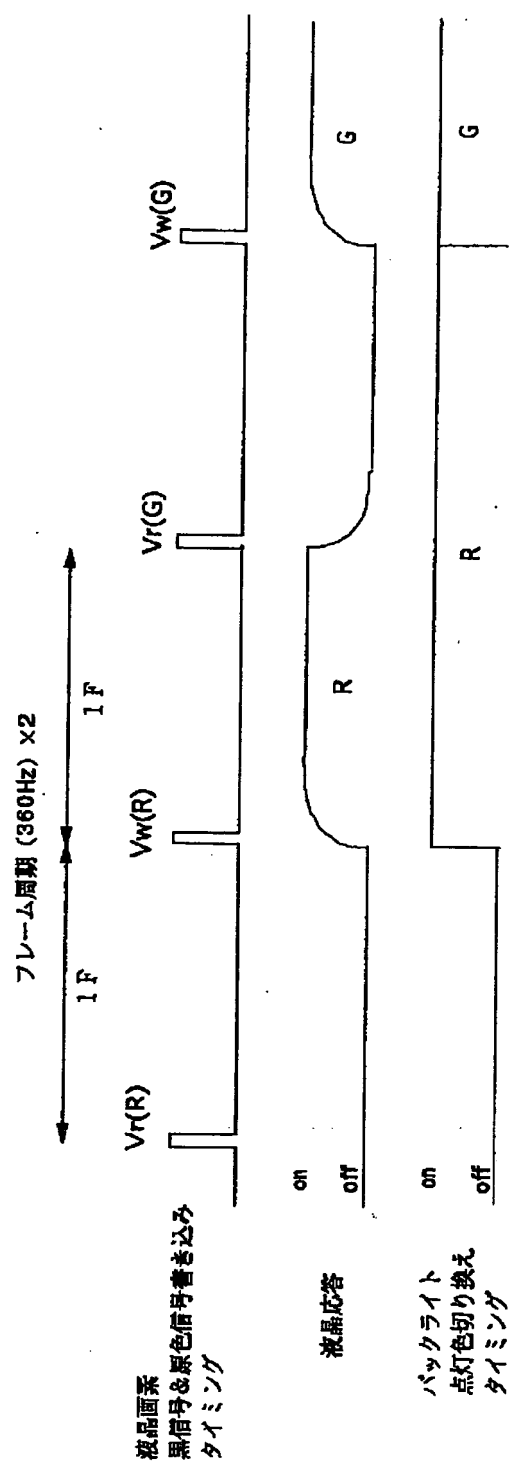


スキャン表示例（ある瞬間その2）

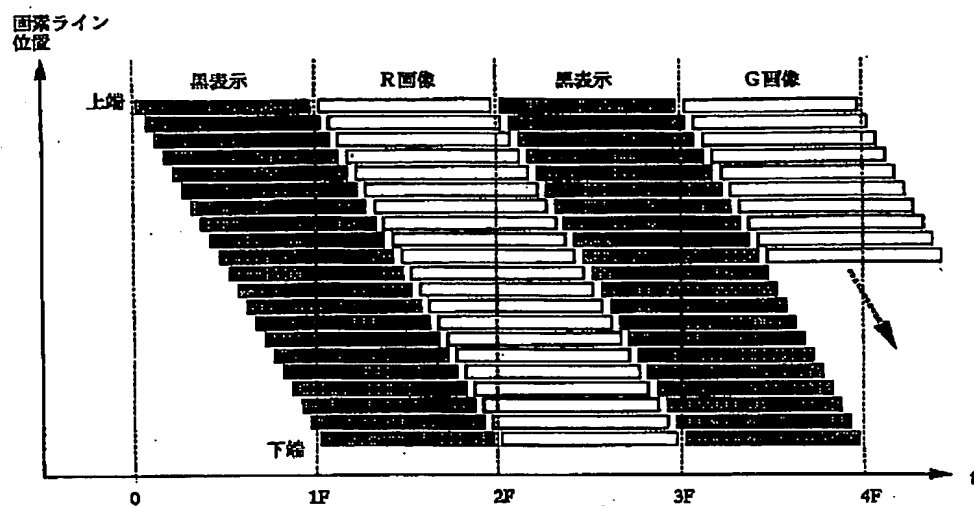
[Drawing 5]



[Drawing 10]



[Drawing 9]



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